THE UNION OF UNUNITED FRACTURES OF THE NECK OF THE FEMUR BY OPEN OPERATION.[1]

BY LEONARD FREEMAN, M.D.,

OF DENVER, COLORADO.

IN spite of the disability often accompanying ununited fractures of the femoral neck, the union of the fragments by open operation has attracted but little attention, although it is feasible and seems to give fairly good results. There are various reasons for this neglect, the principal one being that the condition is usually encountered in old people with poor resisting powers, so that an operation of such magnitude would be accompanied by more danger than would be compensated for by the advantages gained. This does not apply, however, to those who are younger and more vigorous and in whom the function of the limb is of paramount importance.

Notwithstanding the comparative rarity of fracture of the neck of the femur in the young and middle-aged, it is surprising how few of these operations have been performed. In the literature at my command, I have been able to find the reports of but thirteen cases, my own making fourteen; while most text-books mention the subject but casually, if at all. Out of these fourteen cases, the final results are given in but ten.

Although the operation was done by von Langenbeck as early as 1858, his patient dying of hospital gangrene, and was favorably spoken of by Trendelenburg at the German Surgical Congress in 1878, it remained for Loreta to report the first successful attempt some ten years later. In this country, Willy Meyer seems to have been the first to operate, in 1893.

THE CHOICE OF CASES FOR OPERATION is of great importance. It should be considered from three points of view, —age of the patient, resisting powers, and amount of disability.

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[1] Read before the Chicago Surgical Society, May, 1904.

Advanced age is a contraindication, although, if an individual were not too old and his general condition exceptionally good, operative intervention might deserve serious consideration. The greatest field, however, necessarily lies among the young and middle-aged, where operation is not only permissible, but strongly indicated.

The resisting powers deserve the most careful attention, but it should be remembered that they are sometimes better in the old than in the young. Chronic and acute derangements of various organs, particularly the kidneys and lungs, must be given due weight before recommending operation.

The amount of disability is an important factor and must of course be considered with reference to the age. A moderate limp without pain or undue loss of function would hardly be sufficient ground for operation, especially as some degree of shortening would be almost sure to remain; but if disability and suffering were pronounced, operation would be strongly indicated in favorable cases.

It is worthy of mention that at various times the open operation has been advised for recent fractures. The suggestion has not been adopted, however, by the great majority of surgeons, even in younger subjects in good physical condition, because the chances of obtaining satisfactory results by less severe and dangerous methods are too good to be disregarded.

OPERATION.—(*a*) *Incision.* Formerly the question of postoperative drainage was of so much importance that it led to the frequent choice of posterior incisions; but, now that more confidence exists in aseptic *technique,* preference can be given to the anterior incision, which seems to offer greater advantages. Access to the joint, even in heavy individuals, is adequate; no muscles or other structures of importance are divided or even endangered; the absence of a wound back of the trochanter lessens the risk of infection, and permits a

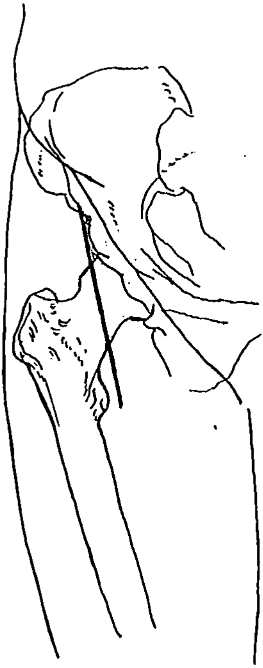

FIG. 1.—Jacobson.

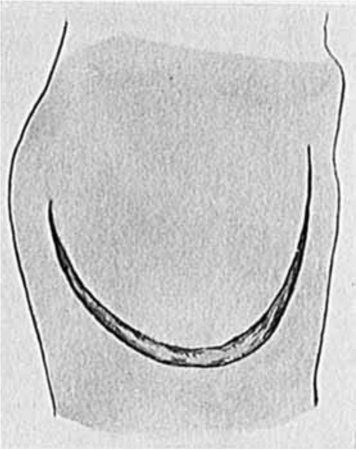

FIG. 2.—Gillette.

cushion to be placed behind the bone in such a way as to prevent its dropping backward, a point of considerable importance; and, lastly, the situation of the wound facilitates the after-treatment, including the removal of stitches, without the necessity of painful and troublesome turning of the patient.

The cut should begin a short distance below and external to the anterior superior spinous process of the ilium and extend directly downward for three or four inches, the exact distance varying somewhat according to the thickness of the soft parts. (Fig. 1.) It should lie just outside the sartorius muscle, which can be retracted inward, while the fascia lata is drawn outward. The dissection should be blunt as far as possible, especially at its lower extremity. Should the surgeon, during the course of the operation, conclude to remove the head of the bone instead of reuniting the fragments, he can do so through this incision quite as readily as through any other.

I can see no advantage in incisions which curve around the tip of the trochanter, and the resulting division of muscular attachments must at times be detrimental.

The osteoplastic operation employed by Gillette and Boeckman (*Transactions of American Orthopædic Association*, Vol. xi, p. 241), although ingenious and giving ample access to the part, seems uselessly complicated and severe, and in case of infection might lead to necrosis or to the existence of two ununited fractures instead of one. It consists of exposing the upper end of the femur by turning up a large horseshoe flap (Fig. 2), dividing the base of the trochanter with a chain-saw and turning it upward together with its muscular attachments. At the conclusion of the operation the fragment is replaced and held by a peg of bone.

(*b*) *Freshening of Fragments.*—This includes the removal of all interposed connective tissue, which, owing to the narrowness of the working-space, may be quite difficult and accompanied by considerable oozing, as in my own case. This tissue is very tough, and cannot be scraped out, but must be cut away with scissors.

The surfaces of the fragments, which are usually abnormally soft, are easily chipped away with a chisel or scraped off with a curette, care being taken to remove as little bone as possible in order to avoid shortening of the neck and, as a consequence, shortening of the entire limb, which is apt to be considerable in spite of all precautions. Troublesome oozing may be checked by the use of pressure-sponges wrung out of very hot water. Detached splinters of bone should be removed.

(*c*) *Fixation of Fragments.*—This is an important and difficult problem. From lack of fixation came the original pseudarthrosis, and upon the degree of its attainment may depend the ultimate results. Whatever method is adopted, the trochanter should be supported from behind, as it has a marked tendency to drop backward, thus producing displacement of the fragments and outward rotation of the limb. This can be done by a cushion or by an appropriate plaster-of-Paris dressing.

It cannot be denied that simple extension, combined with trochanteric support, would be sufficient to secure union in many instances; and, in fact, I am convinced that the results in a number of reported cases have been obtained by these means alone. This is more easily understood when we remember that union has failed in many instances, not because extension has failed, but because the seriousness of the injury was not recognized and extension was not employed.

It is perhaps unwise, however, to trust to extension alone, even when combined with support of the trochanter by a plaster cast surrounding the pelvis, because there are other procedures supposed to be more certain in their results. The principal one of these is the union of the fragments by means of nails, screws, or bone or ivory pegs. These may be inserted obliquely from the incision used in opening the joint, or more advantageously through a small separate opening over the external surface of the trochanter, which permits of better fixation and more easy removal. This method of holding the frag-

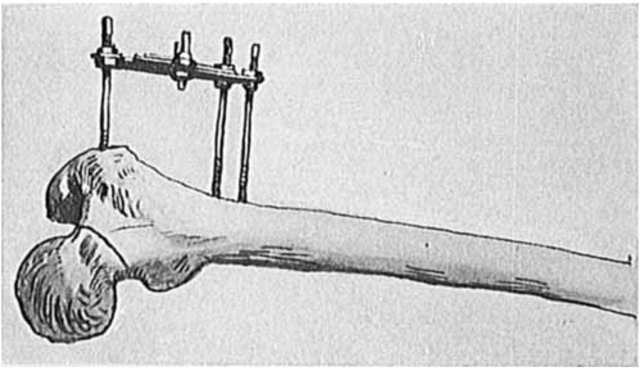

FIG. 3.—Parkhill's fixation apparatus.

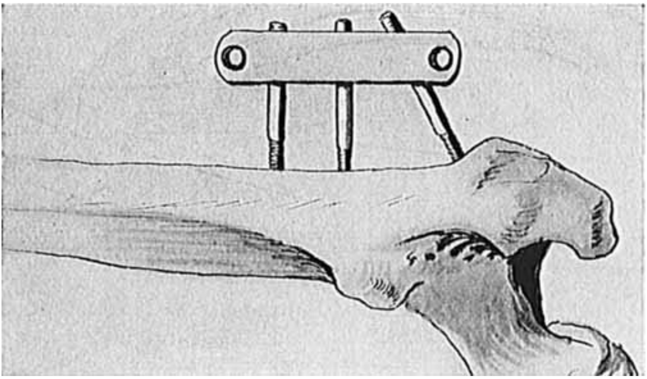

FIG. 4.—Method of securing screw in fracture of neck of femur; the wooden plates embracing screws

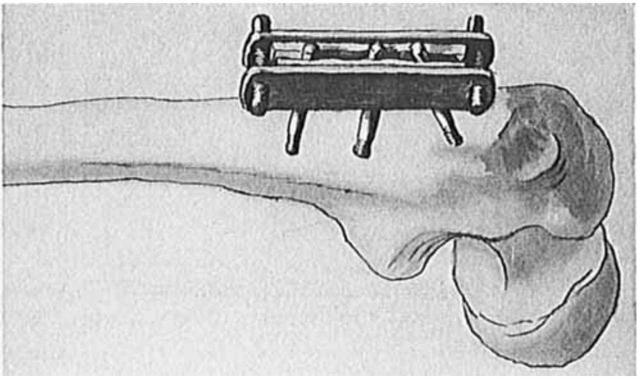

FIG. 5.—Completed screw and clamp apparatus for fixation of fracture of neck of femur.

ments is supposed to accomplish three things,—fixation, coaptation, and stimulation of bone formation.

Without special consideration, it would appear that perfect immobility of the pieces of broken bone could always be obtained by nails, pegs, or screws, especially the last mentioned. But this is not true, although it seems to have been taken for granted by all operators and writers, the reason being that the upper end of the femur often becomes so extremely soft and porous that the instruments of fixation will not hold. In my own case, and it has been noted by others, this softening was so marked that the screw could be pushed directly through the bone without previous drilling, the union being thus rendered so insecure that a very moderate degree of force was sufficient to reproduce displacement.

In order to obtain thorough fixation, Clayton Parkhill suggested the use of his well-known bone-clamp (ANNALS OF SURGERY, 1898, Vol. xxvii, p. 560); although, so far as I know, the suggestion has never been put in practice. This clamp is so constructed, however, that if the upper leg were inclined upward, as it would have to be, it would be very hard to fasten the wings of the apparatus together. (Fig. 3.) This difficulty may be easily overcome by making use of a much more simple and equally effective clamp which I devised some time ago and successfully employed in two cases of ununited fracture of the tibia. It consists of three or four long screws, which are inserted in a longitudinal line of holes drilled in the bone, their projecting ends being tightly held by two metal side-clamps lined with strips of wood. The efficiency of the apparatus lies in the fact that the screws bury themselves in the wood as firmly as if screwed into it. As regards the hip, it would make no difference at what vertical angle the upper screw projected from the bone, it could be easily adjusted and securely held. Such an apparatus, having its foundation two or three inches down the shaft of the femur, in solid bone, would certainly be more satisfactory than screws alone. (Figs. 4 and 5.)

The use of absorbable bone or ivory pegs is alluring because they can be left permanently in the tissues; but as a means of fixation they are less reliable than the methods already mentioned, and in case of infection, which may occur in spite of every precaution, they are difficult to remove. Wiring the fragments, although hard to accomplish properly in such deep-seated structures, would probably be preferable.

It is questionable whether two loosely fitting pegs or screws, passing through soft bone, are in any way superior to one; and the greater the number, the greater the traumatism and the chances of infection. When a bone-clamp is employed as described, one screw would appear to be sufficient.

The insertion of a coil of wire between the ends of the broken bone for a few days only, as was done by Loreta, would seem to have no theoretical justification, although in his case a good result was obtained.

When to remove the screws is a difficult question. They should remain, if possible, for several weeks, until consolidation is well advanced, unless infection occur, when they should be taken out at once. In my own case, as in one reported by G. G. Davis, fever appeared at the end of the second week. The removal of the screws, which were surrounded by infective material, caused a rapid subsidence of the symptoms.

(*d*) *Drainage.*—Temporary drainage of the wound is indicated, although depending somewhat upon the amount of oozing. When an anterior incision has been employed, I cannot believe it is wise to incise the tissues and drain posteriorly, because of the inconvenience of turning the patient in order to change the dressing, and because of the increased likelihood of infection.

(*e*) *Length of Time in Bed.*—This has been placed by the majority of operators at about ten weeks, although both Müller and Gillette permitted patients to get up in six weeks without apparent detriment. The longer time, however, must certainly be safer, because of the softened condition of the bone and its lack of adequate circulation.

RESULTS.—These have been, on the whole, encouraging. Nearly all operators have reported good motion and satisfactory function, although it must be acknowledged that some of the cases were not followed a sufficient length of time. There always remains, however, some shortening, varying from half an inch to an inch and a half or more. This arises from absorption of bone, from loss by freshening the fragments, and from imperfect adjustment; but it is usually not great enough to become a large factor in the final result.

WRITER'S CASE.—A heavy, muscular man, thirty-two years of age, injured the right hip by falling on it, May 2, 1903. He was up on crutches in about four weeks, the extent of the injury not having been recognized. When I saw him on September 23, 1903, he was still unable to use the limb in walking, owing to pain in the hip and knee. There was shortening of two and a half inches with a corresponding elevation of the trochanter, although this could easily be overcome by traction, the manipulation being accompanied by indistinct crepitus.

Operation (October 10, 1903, about five months after the injury).—Anterior longitudinal incision external to the sartorius, through which the neck of the femur was readily exposed, and the fracture located near the head of the bone. With difficulty a mass of tough fibrous tissue was snipped with scissors from between the ends of the fragments, which were freshened on each side of the gap with a chisel. A small incision was then made over the trochanter externally, and a hole for the reception of a screw drilled through the base of the trochanter, the external fragment of the neck, and into the head of the bone. The "drilling," however, proved to be a mere form, for the bone was so soft that the blunt screw could have been pushed directly through it without the boring of a preliminary hole. When the screw was in place, its outer end projected between the stitches used in closing the wound. Owing to the softness of the bone, the parts, although receiving considerable support, were far from being firmly held, so that it was possible to displace them with moderate force by rotating the limb or pushing it upward.

On account of oozing, it was necessary to pack the wound with a strip of gauze, which was removed in a day or two, the opening closed, and primary union obtained. Extension, a long side-splint, and a pad beneath the trochanter were employed. For several days the suffering was great, necessitating the constant use of morphine.

In a week or so a little infection appeared about the opening, through which projected the screw, which at the end of about two weeks caused a rise in temperature to nearly 104 degrees, accompanied by chills and much general disturbance. On removal of the screw, however, these unfavorable symptoms promptly subsided, showing that they were probably due to infection of the cancellous structure rather than the joint (Davis reports a similar experience). The subsequent recovery was rapid and uninterrupted.

The extension was removed in about eight weeks, and the patient permitted to use crutches in ten weeks. Much callus could be detected, and there was about one inch shortening. In the face of various tests, the union seemed to be sound and bony.

When the patient left the hospital at the end of twelve weeks, he could bear his weight upon the limb without yielding at the seat of the fracture, and there was satisfactory movement in the joint as regards both flexion and rotation. I examined this patient again a little over six months after the operation, and found the following condition: union apparently firm, considerable callus, flexion to nearly a right angle, rotation almost normal, and about one and a half inches shortening. There was still enough pain in the joint anteriorly to prevent the patient discarding his crutches, although it was much less than before the operation and was decreasing constantly. When not attempting to walk, the weight could be borne upon the limb with but little, if any, discomfort.

Hence, up to the present time this case has not been a complete success, the result being marked improvement only. What the ultimate outcome will be is yet to be ascertained.

OTHER CASES.—(1) VON LANGENBECK, in 1858 (*Charité Annalen*, 1858), operated upon an ununited fracture of the neck of the femur by incision and screws, death occurring from sepsis and hospital gangrene.

(2) LORETA (*British Medical Journal*, August 25, 1888). Man of thirty-six; fracture at capsular junction nineteen months previous to operation. Long incision behind trochanter. Fragments freshened by scraping. Attempted to wire fragments, but failed, and simply placed a

bundle of wires between them, which was removed in five days. Primary union. Able to walk in fifty-five days.

(3) W. Müller (*Samm. klin. Vortr.*, No. 145, 1896, p. 929). Woman of fifty-four. Injury two and a half years previous to operation. Anterior longitudinal incision external to sartorius. Fracture in centre of neck. Freshened fragments with chisel. Drill inserted obliquely through fragments from anterior wound and left in ten days. Extension. Out of bed in six weeks. Complete consolidation in twelve weeks. At end of three and a half years could walk several hours without inconvenience. Perfect motion in joint.

(4) W. Müller (*Samm. klin. Vortr.*, No. 145, 1896, p. 429). Mere mention of a case operated on in a similar manner to the one reported above. Results not given.

(5) Willy Meyer (Annals of Surgery, 1893, Vol. ii, p. 30). Man of thirty-nine. Injury ten months previous to operation. Langenbeck incision. Employed two long nails inserted through special opening over trochanter. Bone very soft. Extension eight weeks. In bed ten weeks. Bony union and good result.

(6) R. H. Sayre (*Transactions of American Orthopædic Association*, 1898, p. 247) mentions operating upon an ununited fracture of the neck of the femur in a man who had received the injury some months previously. "Incision as for resection of hip." Fragments united by a gimlet which was left in eight weeks. Good union and good functional result.

(7) A. J. Gillette. Operation by E. Boeckmann. (*Transactions of American Orthopædic Association*, 1898, p. 241.) Man of thirty-six. Injury six months previous to operation. Through a horseshoe incision the trochanter was divided at its base and turned upward, together with its muscular attachments. Bone pegs were employed to reunite both the fragments and the trochanter. Silica spica dressing. Primary union. In bed sixteen weeks. On crutches ten days. At end of a year was walking without a cane and with satisfactory motion of joint.

(8) A. J. Gillette (*Ibid.*). Woman of twenty-three. Injury fourteen months previously. Operation similar to above, except ivory pegs were used. Primary union. In bed eight weeks. At end of about one year there was one inch shortening, normal motion, and good function.

(9) Man of thirty-six. Injury six months previously. Operation similar to above. Primary union. In bed six weeks. Result,—a little over one inch shortening, relief from pain, slight limp, able to do manual labor at end of one year.

(10) G. G. Davis (*University Medical Magazine*, September, 1900). Man of thirty-eight. Injury one year previous to operation. Anterior longitudinal incision external to sartorius. Fragments freshened by gouge and curette and united by two long steel drills passed through a separate incision over trochanter. At end of two weeks temperature went to 105 degrees, with chills, fever, and sweats. Pins removed in three weeks, when septic symptoms ceased at once. Extension and fixation then applied. Up and about in ten weeks with apparently firm union and

good functional results. On March 29, 1904, Dr. Davis writes me that the fragments "again became loose after some months, and I inserted two large (three-inch) silver-plated wood screws. This hip was firm over two years after the operation, and has, I presume, remained so, or I would have heard from the patient."

(11) G. G. DAVIS (*Ibid.*). Man of thirty-five. Injury six months previous to operation. Anterior longitudinal incision external to sartorius. Intracapsular fracture. Through incision over trochanter, two ivory pegs, three and two-fifths inches long, driven through fragments. Plaster dressing from waist to below knee. Primary healing. Bony union apparently and good functional result. Dr. Davis writes me (March 29, 1904) that the fracture "has become somewhat loose from the subsequent breaking or loosening of the ivory pegs."

(12) W. W. KEEN (mere mention of unreported case in letter from G. G. Davis). A three-inch, steel, silver-plated screw employed. Result good at end of three and a half months.

(13) G. G. DAVIS (private communication). Apparently firm union when case left hospital, but ultimate result unknown.

In addition to the above list, which is no doubt incomplete, F. Kammerer (ANNALS OF SURGERY, 1899, Vol. i, p. 624) alludes to a case of ununited fracture of the femoral neck in which he attempted to unite the fragments, but could not approximate them sufficiently. He accordingly abandoned the attempt and resorted to resection of the head of the bone instead.

An interesting case is also reported by M. Gangolphe (*Revue de Chirurgie*, 1899, Vol. ii, p. 763) which deserves mention, although it does not come strictly under the heading of this paper:

Man, aged thirty-nine. Injury eight months previous to operation. Intracapsular fracture with splintered neck. Divided trochanter, turned its base inward and united it to the freshened upper fragment of the neck. After union had taken place, a bony support was obtained, against which the shaft of the femur rested. At the end of three years (*Revue de Chirurgie*, 1901, Vol. ii, p. 585), the patient could walk long distances and carry heavy loads.